

Two new freshwater crabs of the genus *Geothelphusa* Stimpson, 1858 (Crustacea: Decapoda: Brachyura: Potamidae) from islands of southern Kyushu, Japan

Hiroshi Suzuki and Toshiaki Kawai

Abstract.— Two new freshwater crabs, *Geothelphusa koshikiensis* and *G. mishima*, are described from Koshiki Islands, and Uji, Kuchierabu and Kuroshima (one of the Mishima Islands) of Kagoshima Prefecture, southern Kyushu, Japan, respectively. Both species have previously been confounded with *G. dehaani*, widely distributed in Japanese mainland (Kyushu to Honshu). The new species are differentiated from one another and other congeners by morphological characters and coloration in life.

Introduction

The freshwater crab, genus *Geothelphusa* Stimpson, 1858, is characterized by the carapace being rounded and smooth, the anterolateral margin convex, the epigastric and postorbital cristae absent, the saber-like male first gonopod (G1) with cone-shaped ultimate segment, and the presence of a synovial membrane between ultimate and penultimate segments of G1 (Stimpson, 1858; Bott, 1970; Shy *et al.*, 1994; Dai, 1999). Members of the genus are distributed in Taiwan, Ryukyu Islands, and the Japanese mainland. A large number of species have been reported from Taiwan and Ryukyu Islands, and 50 species are now recognized in the genus (Shy *et al.*, 1994; Shy & Ng, 1998; Tan & Liu, 1998; Shokita *et al.*, 2002; Naruse *et al.*, 2004, 2005, 2006, 2007; Naruse & Shokita, 2009; Ng *et al.*, 2008; Shih & Shy, 2009; Shih *et al.*, 2010). In Japan, 16 species including two subspecies are currently known, viz., *G. dehaani* (White,

1847), *G. obtusipes* Stimpson, 1858, *G. levicervix* (Rathbun, 1898), *G. sakamotoana* (Rathbun, 1905), *G. tenuimanus* (Miyake & Minei, 1965), *G. aramotoi* Minei, 1973, *G. exigua* Suzuki & Tsuda, 1994, *G. minei* Shy & Ng, 1998, *G. shokitai* Shy & Ng, 1998, *G. marmorata* Suzuki & Okano, 2000, *G. miyakoensis* Shokita, Naruse & Fujita, 2002, *G. marginata fulva* Naruse, Shokita & Shy, 2004, *G. marginata maruginata* Naruse, Shokita & Shy, 2004, *G. grandiovata* Naruse, Shokita & Ng, 2006, *G. iheya* Naruse, Shokita & Ng, 2006, *G. kumejima* Naruse, Shokita & Ng, 2006, and *G. amagui* Naruse & Shokita, 2009 (De Haan, 1835; Rathbun, 1904; Bott, 1967; Minei, 1974; Suzuki & Tsuda, 1994; Suzuki & Okano, 2000; Kasai & Naruse, 2003). All but *G. dehaani* and *G. exigua* are endemic to the Ryukyu Islands; *G. dehaani* has been reported from the Japanese mainland (Tohoku to Kyushu districts) and islands of Kyushu; and *G. exigua* is endemic to the Ohsumi Peninsula, Kagoshima Prefecture, Kyushu. Although several color variants, reflecting geographical distribution have been recognized, it has been considered that these populations all belong to a single species, *G. dehaani* (Chokki, 1976, 1980; Sugawara & Gamo, 1984; Nakajima & Masuda, 1985; Suzuki & Tsuda, 1991; Suzuki & Sato, 1994). Also, minor morphological differences in the pereopods and G1 have been reported among some populations with different color (Sugawara & Gamo, 1984; Nakajima & Masuda, 1985). Okano *et al.* (2000) studied on the population genetics and geographic distribution of *G. dehaani* in southern Kyushu and neighboring islands, and reported that

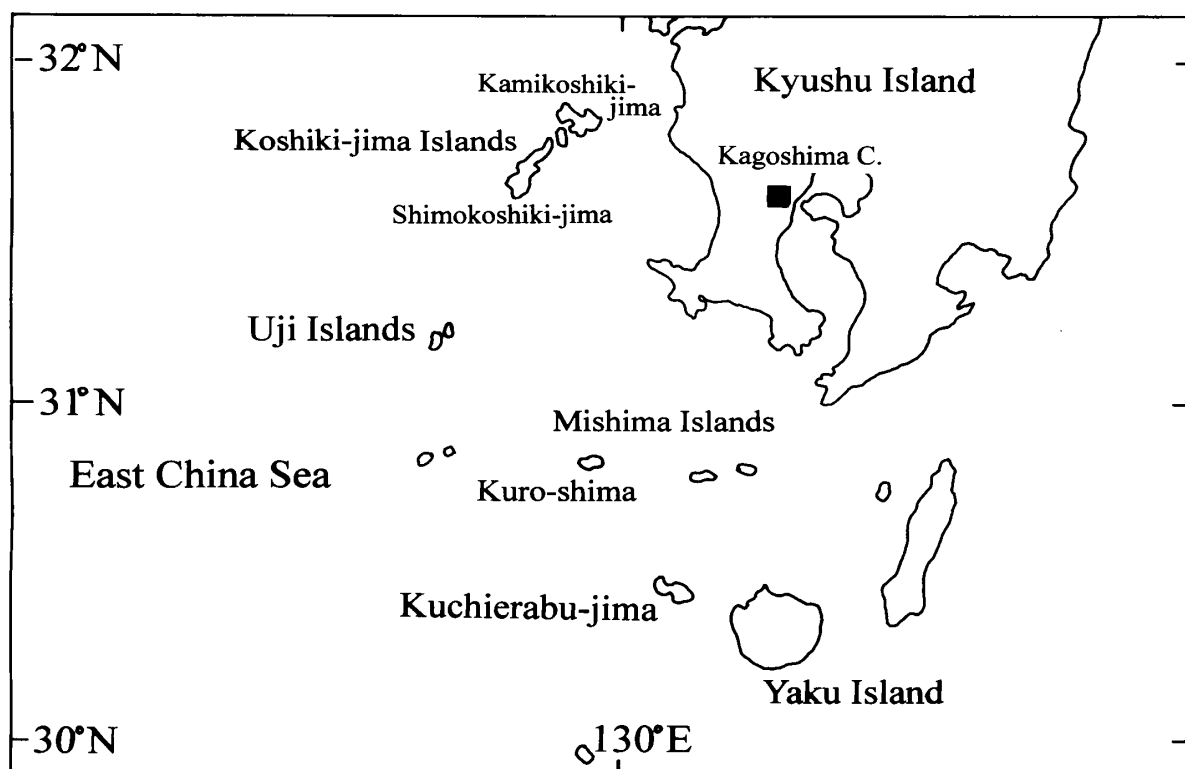


Fig. 1. The map showing the locations of islands of southern Kyushu.

there were two genetically isolated groups among the populations of the islands, including Koshiki, Uji, Kuchierabu and Kuroshima islands in Kagoshima Prefecture (Fig. 1). In this study, specimens from these islands have been carefully examined morphologically. It has been confirmed that these two groups can be distinguished from *G. dehaani* by some morphological characters and live coloration. Consequently, two new species are herein described, *G. koshikiensis* for the population occurring on the Koshiki Islands, and *G. mishima* for the population on the Uji, Kuchierabu and Mishima Islands.

The holotypes and paratypes are deposited in the University Museum in Kagoshima University (KAUM), and paratypes are also in the Marine Biological Laboratory, Faculty of Fisheries, Kagoshima University, Kagoshima (KUMB) and in the Raffles Museum of Biodiversity Research, National University of Singapore (ZRC). Measurements shown in parentheses under "Material examined" indicate the maximum carapace width in millimeters. Abbreviations used include: G1,

first gonopod; G2, second gonopod; M, male; F, female; CL, carapace length; CW, carapace width.

Taxonomic Account

Family Potamidae Ortmann, 1896

Genus *Geothelphusa* Stimpson, 1858

Geothelphusa koshikiensis, new species

Figs. 2-3, 4a

[New Japanese name: Koshiki-sawagani]

Geothelphusa dehaani: Suzuki & Tsuda, 1991: figs 2a, 3; Okano *et al.*, 2000: Table 1, fig. 2D.

Material examined.— Holotype. Shimo-koshiki island: Kanai River, 30 Aug 1997, M (28.5; KAUM-AT-131).

Paratypes. Shimo-koshiki island: Kanai River, 30 Aug 1997, 3 FF (16.0, 24.3, 26.3; KUMBcr 1145), 4 MM (22.4, 22.6, 24.5, 24.6; KUMBcr 1147); E-gawa River, 29 Aug 1997, M and F (23.9, 28.9; ZRC 2011.0817); same data, used for electrophoretic analysis in Okano *et al.* (2000), 7 FF (22.6 - 30.4;

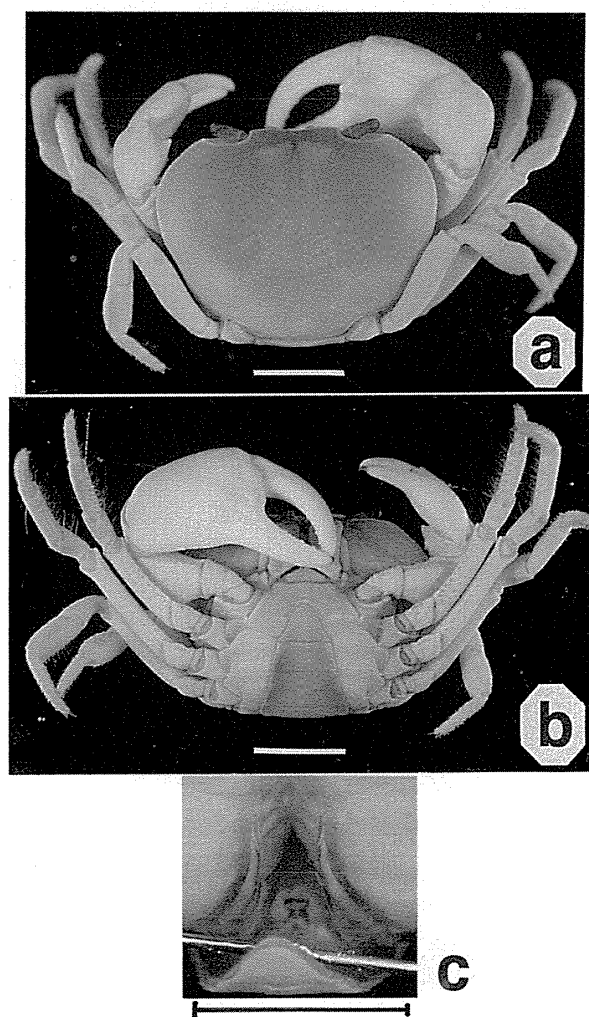


Fig. 2. *Geothelphusa koshikiensis*, new species, male holotype (KAUM-AT-131). a, dorsal view; b, ventral view; c, close up view of sternal cavity with abdomen lifted. Scale bars indicate 10 mm.

KUMBcr 1151), 7 MM (18.8 - 22.4; KUMBcr 1153); same locality, 14 Sept 1999, F (24.6; KAUM-AT-134), M (23.7; KUMBcr 1139), M (27.0; KUMBcr 1140); Sanoura, 4 Jun 1987, M (20.1; KUMBcr 1144), 17 FF (13.3 - 26.8; KUMBcr 1148); Nagahama River, 19 May 1998, used for electrophoretic analysis in Okano *et al.* (2000), 13 MM (14.2 - 28.6; KUMBcr 1150), 6 FF (11.6 - 26.7; KUMBcr 1156); Seo-Ohkawa River, 30 Aug 1997, used for electrophoretic analysis in Okano *et al.* (2000), 16 MM (12.6 - 26.3; KUMBcr 1152), 10 FF (13.1 - 25.7; KUMBcr 1154); Hamada River, 30 Aug 1997, used for electrophoretic analysis in Okano *et al.* (2000), 10 MM and

5 FF (16.5 - 27.2, 13.1, 16.9, 22.0, 23.6, 24.4; KUMBcr 1157). Naka-koshiki island: Iwao River, 16 Sept 1999, M (21.4; KUMBcr 1136), F (23.0; KUMBcr 1143); none locality name, 16 Sep 1999, 2 MM (23.6, 27.1; KUMBcr 1141 - 1142). Kami-koshiki island: Nakatsu River, 16 Sept 1999, M (28.3; KAUM-AT-132), F (29.2; KAUM-AT-133), 3 MM (22.1, 25.7, 21.1; KUMBcr 1135, KUMBcr 1137 - 1138); same locality, 20 July 1997, 2 FF (21.5, 27.1; KUMBcr 1146); same data, used for electrophoretic analysis in Okano *et al.* (2000), 5 MM (16.8, 20.4, 22.6, 22.9, 25.6; KUMBcr 1155).

Diagnosis.— Carapace with greatest width across anterior 0.30 ± 0.03 of length ($N=12$); anterolateral margin cristate, lined with fine, rounded granules; infraorbital margin cristate; sulcus on pterygostomial region accompanied with crista, not filled with granules. Carpus of male major cheliped almost smooth, inner surface with stout upper tooth and lower spiniform projection. G1 with penultimate segment almost straight; ultimate segment straight, bearing short terminal process. In life, carapace dark reddish brown; chelipeds red; ambulatory legs reddish brown.

Description.— Carapace much broader than long, 1.30 ± 0.03 ($N=108$), greatest width across anterior 0.30 ± 0.03 of length ($N=12$); dorsal surface smooth, naked (Figs. 2a, 3a); faint, short oblique striae on epibranchial and posterolateral regions; epi- and uro-gastric regions distinct; H-shaped median gastro-cardiac depression moderately deep; deep transverse groove present between cardiac and intestinal regions; cervical groove obsolete on epibranchial region. Anterolateral margin of carapace cristate, lined with fine rounded granules; epibranchial tooth rudimentary. Infraorbital margin cristate, smooth; and sulcus of pterygostomial region with crista, not lined with granules.

Eyestalk short, gently constricted subproximally; cornea moderately developed (Figs. 2a, 3a).

Third maxilliped with ischium bearing faint median sulcus on proximal third. Merus broad, squarish, with two depressions delimited by median longitudinal ridge (Fig. 3b), carpus articulated to inner distal angle of merus, dactylus exposed when flexed; tip of

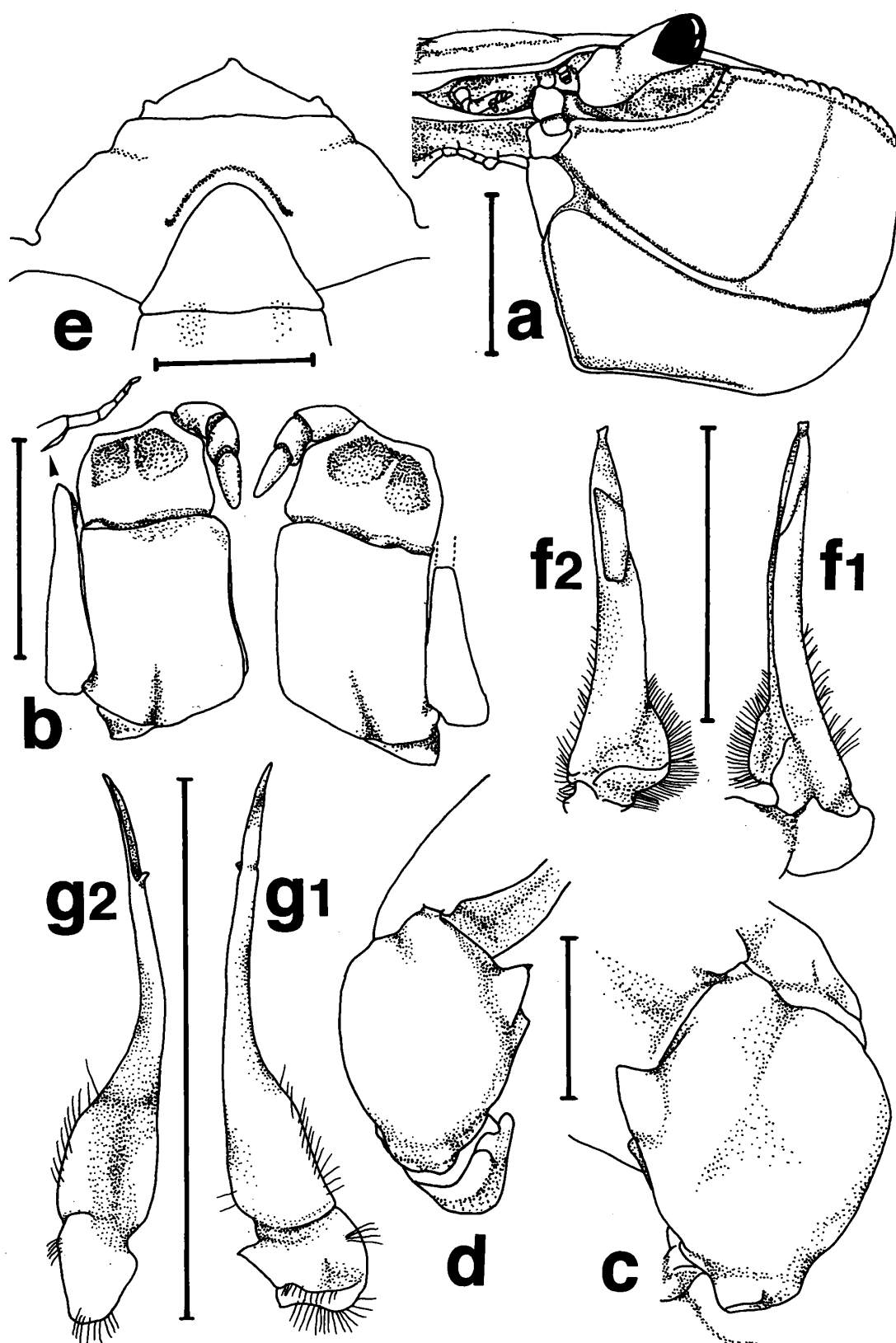


Fig. 3. *Geothelphusa koshikiensis*, new species, male holotype (KAUM-AT-131). a, cephalothorax, left side of frontal view; b, third maxillipeds, frontal view and a flagellum of exopod; c, dorsal view of carpus of major cheliped; d, dorsal view of carpus of minor cheliped; e, ventral view of telson and anterior part of thoracic sternum; f, left first gonopod, ventral (f1) and dorsal (f2) views; g, left second gonopod, ventral (g1) and dorsal (g2) views. Scale bars indicate 1 mm.

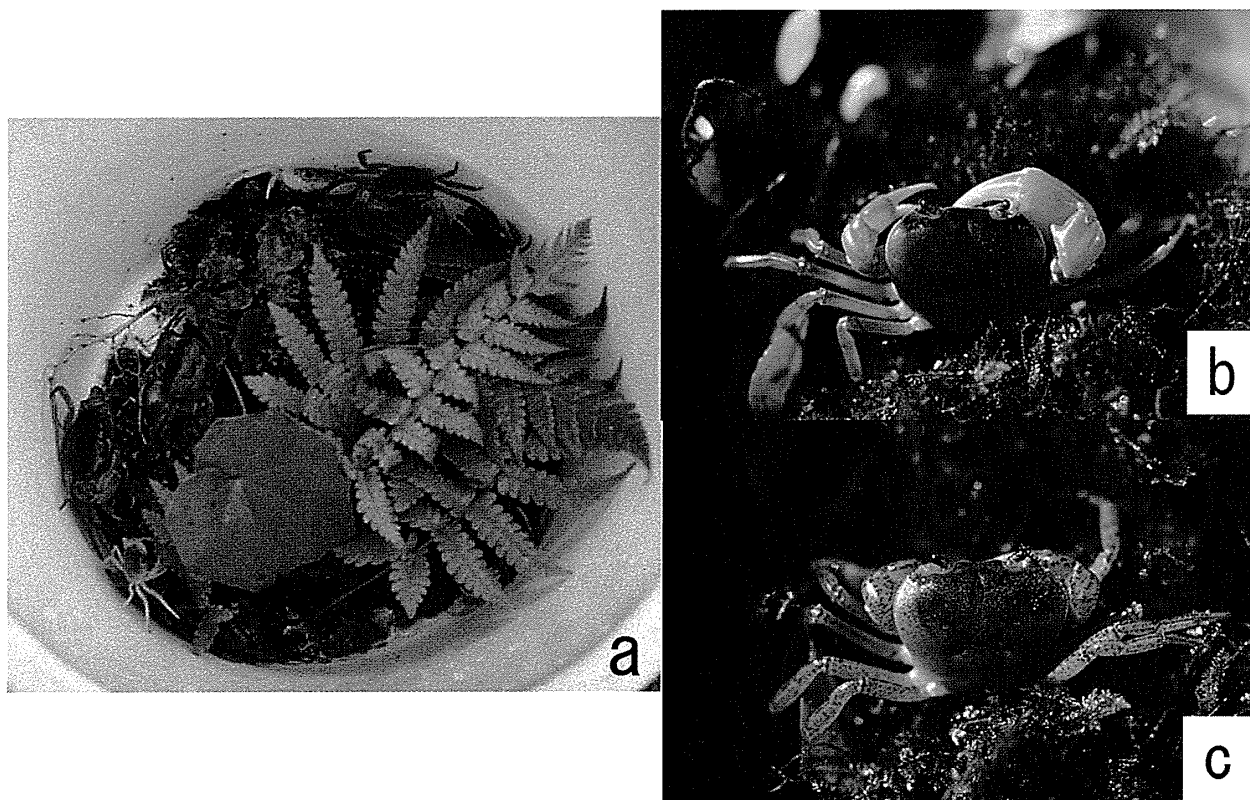


Fig. 4. Live coloration of *Geothelphusa koshikiensis*, new species (dark reddish brown color in a), *G. dehaani* (White, 1847) (milky white color in a), and *Geothelphusa mishima*, new species (b and c).

dactylus not reaching distomesial angle of ischium. Exopod slender, longer than ischium, with short 5-articulated flagellum not reaching mesial margin of merus.

Male chelipeds asymmetrical (Fig. 2a, b). Major cheliped with dactylus strongly curved in larger males (more than 25 mm in CW), less curved in smaller males (less than 25 mm in CW); palm smooth, outer surfaces convex (Fig. 2a); carpus almost smooth, inner surface with stout upper tooth and lower spiniform projection (Fig. 3c). Minor cheliped with carpus bearing tiny lower projection and stout upper tooth (Fig. 3d). Female chelipeds symmetrical; generally similar to male minor cheliped.

G1 with penultimate segment almost straight with slightly concave lateral margin (Figs. 2c, 3f); synovial membrane about 3 times as long as broad; ultimate segment straight, tapering distally, with short, distally widened terminal process. G2 shorter than G1, the ratio of the length of G2 vs G1 in Holotype is 0.78, not reaching aperture of G1

in situ, slender, flattened, having small cup-like structure located at distal one-fourth; proximolateral margin slightly convex; distal part forming longitudinal concavity (Fig. 3g).

Anterior thoracic sternum with distinct curved crista along anterior margin of sterno-abdominal cavity (Fig. 3e). Male telson triangular with rounded tip; lateral margins faintly to slightly concave (Figs. 2b, 3e).

Color in life.— Carapace dark reddish brown; chelipeds red; ambulatory legs reddish brown (Fig. 4a). In large male, lower part of palm and immovable finger of both chelipeds white and upper parts of palm and dactylus red. In small males and females, lower part of palm white, fingers and upper part of palm red. Otherwise, no color variation observed between sexes and sizes.

Etymology.— The specific name is named after type locality, Koshiki Islands.

Distribution.— Known only from Koshiki Islands (Kami- and Shimo-koshiki islands).

Geothelphusa mishima, new species

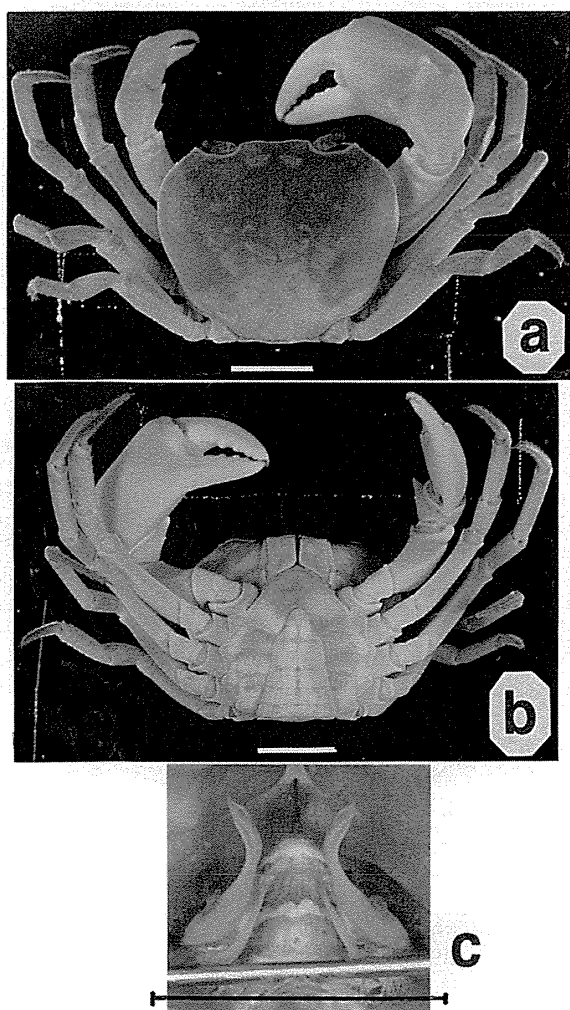


Fig. 5. *Geothelphusa mishima*, new species, male holotype (KAUM-AT-135): a, dorsal view; b, ventral view; c, close up view of sternal cavity with abdomen lifted. Scale bars indicate 10 mm.

Figs. 4b, c, 5-6

[New Japanese name: Mishima-sawagani]

Geothelphusa dehaani: Okano *et al.*, 2000: Table 1, fig 2E; Suzuki, 2001: fig. 4.

Material examined.— Holotype. Kuroshima Island, Mishima Islands, near Higurashi River, 28 Sep 1999, M (27.6; KAUM-AT-135).

Paratype. Kuroshima Island, Mishima Islands: near Higurashi River, 28 Sep 1999, 7 MM (23.5, 25.0, 21.3, 19.9, 21.2, 20.0, 18.1; KUMBcr 1159 – 1165), 5 FF (15.1, 17.2, 18.5, 24.0, 24.7; KUMBcr 1172), F (25.1; KAUM-AT-136); Nago River, 28 Sep 1999, M and F (21.0, 25.0; KAUM-AT-137), M (for

sketch; 20.4; KUMBcr 1158), 2 MM (20.0, 21.9; KUMBcr 1166 and 1168), M (19.6; ZRC 2011.0818), 2 FF (16.4, 29.8; ZRC 2011.0819), 2 MM and F (14.6, 15.1, 15.9; KUMBcr 1171); same locality, 7 Sep 1996, used for electrophoretic analysis in Okano *et al.* (2000), 3 MM and 4 FF (22.3, 24.1, 24.5, 21.4, 24.7, 25.8, 29.0; KUMBcr 1169). Uji island: none locality name, 7 Aug 1998, 4 MM (31.8, 20.7, 30.4, 20.8; KUMBcr 1173 – 1176), 4 MM and 13 FF (9.5, 10.0, 12.3, 14.1, 9.7 – 28.0; KUMBcr 1177). Kuchierabu island: none locality name, 28 Aug 1997, 9 MM (24.9, 30.8, 22.9, 26.8, 26.2, 26.1, 26.1, 28.9, 23.5; KUMBcr 1178-1186), 2 FF (21.9, 29.7; KUMBcr 1187); same locality, 25 Jun 1990, M (13.4; KUMBcr 1188).

Diagnosis.— Carapace with greatest width across anterior 0.33 ± 0.04 of length ($N=10$); anterolateral margin cristate, lined with fine spiniform granules; infraorbital margin granulate; sulcus on pterygostomial region not accompanied with crista, partially filled with granules. Carpus of chelipeds with two to four spiniform granules on outer surface. G1 with penultimate segment strongly curved laterally; ultimate segment tapering into long terminal process, slightly curved mesially with terminal aperture. In life, carapace and pereopods reddish orange with small black spots; the small black spots in some large specimens obscure.

Description.— Carapace much broader than long, 1.23 ± 0.04 ($N=39$), greatest width across anterior 0.33 ± 0.04 of length ($N=10$) (Figs. 4b, c, 5a); dorsal surface smooth; epigastric region divided into 2 stout gastric cristae by deep median groove; H-shaped median gastro-cardiac depression deep, wide. Anterolateral margin of carapace cristate, lined with fine spiniform granules (Figs. 5a, 6a), or tiny spines in small specimens (Fig. 6b). Infraorbital margin lined with tiny granules (Fig. 6a, b); sulcus on pterygostomial region in large specimens (larger than ca. 23.0 mm in CW) filled with granules in anterior part, in small specimens (less than ca. 23.0 mm in CW) sulcus filled with granules along almost entire length.

Third maxilliped with ischium bearing faint sulcus nearly reaching to anterior margin of ischium; merus squarish, with deep

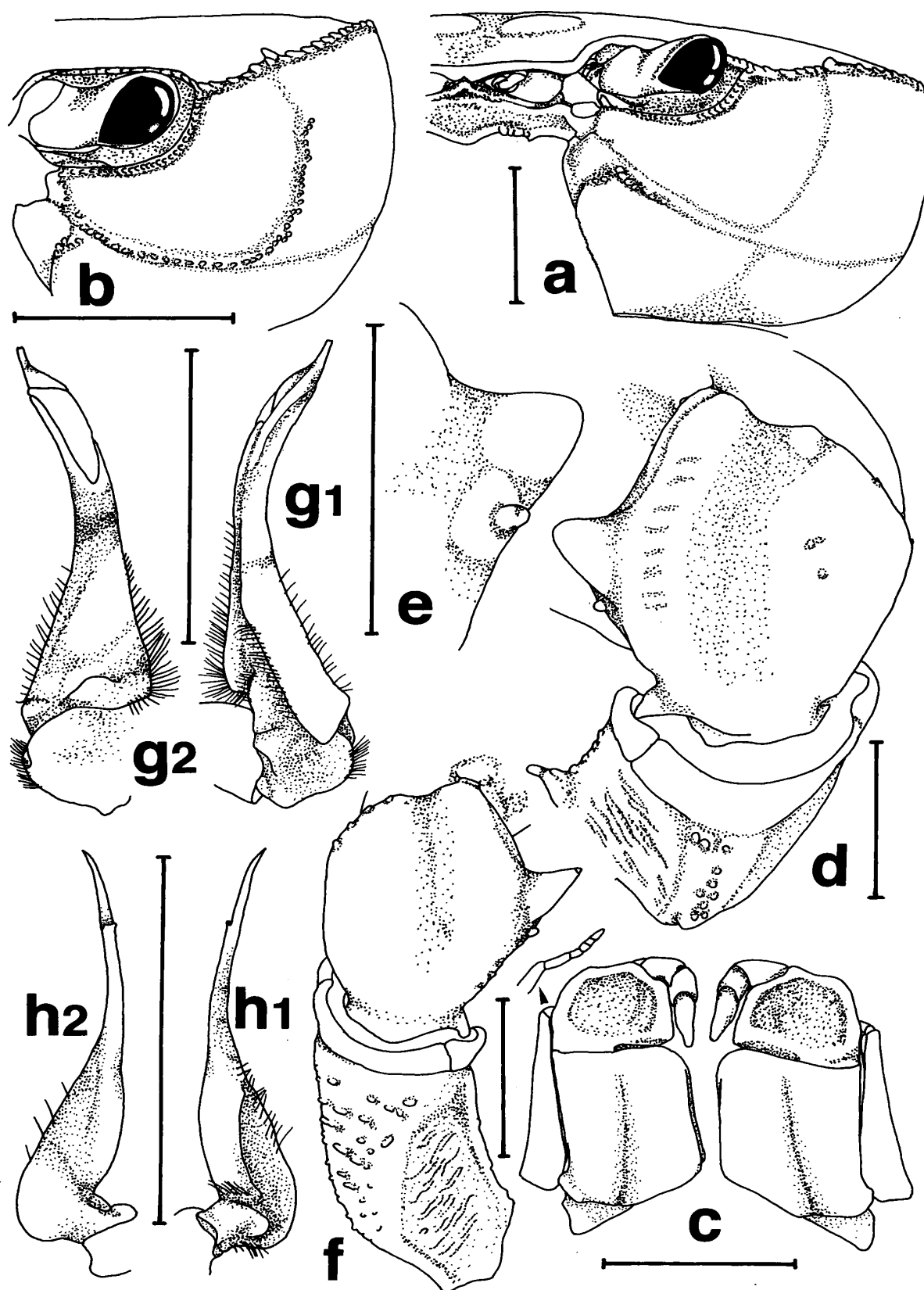


Fig. 6. *Geothelphusa mishima*, new species, a, c-h, male holotype (KAUM-AT-135); b, male paratype (KUMBcr 1158). a, b, left side of cephalothorax, frontal view; c, third maxillipeds, frontal view and a flagellum of exopod; d, dorsal view of carpus of major cheliped; e, close up inner view of carpus of major cheliped; f, dorsal view of carpus and merus of minor cheliped; g, left first gonopod, ventral (g1) and dorsal (g2) views; h, left second gonopod, ventral (h1) and dorsal (h2) views. Scale bars indicate 1 mm.

depression (Figs. 5b, 6c).

Male chelipeds asymmetrical (Fig. 5a, b). Major cheliped with dactylus gently curved; narrow gap between fingers when closed; carpus bearing 3 or 4 small spiniform tubercles on outer surface, inner surface bearing upper tooth and 1 distinct tubercle just inferior to base of upper tooth (Fig. 6d, e). Minor cheliped with carpus bearing upper tooth and tiny tubercle on inner surface and 2 to 4 spiniform tubercles on outer surface (Fig. 6f). Female chelipeds symmetrical; generally similar to male minor cheliped.

G1 with penultimate segment relatively stout, strongly curved laterally with markedly concave lateral margin (Figs. 5c, 6g); synovial membrane about 0.4 x length of penultimate segment; ultimate segment slightly curved mesially, tapering into long terminal process. G2 slender, the ratio of the length of G2 vs G1 in Holotype is 0.76 (Fig. 6h).

Anterior thoracic sternum without crista along anterior margin of sterno-abdominal cavity. Telson triangular with rounded tip; lateral margins somewhat concave (Fig. 5b).

Color in life.—Carapace and pereopods reddish orange with small black spots; the spots in some large specimens obscure (Fig. 4b, c). In large males (over ca. 23.0 mm in CW), lower part of palm and immovable finger, and distal half of dactylus of both chelipeds white, upper part of palm and proximal half of dactylus of chelipeds orange. In small males and females, lower part of palm white, fingers and upper part of palm orange. Otherwise, no color variation observed between sexes and sizes.

Etymology.—The specific name is named after the type locality, Mishima Islands.

Distribution.—Only known from three islands off southern Kyushu, Kuroshima Island in Mishima Islands, Uji Islands, and Kuchierabu Island.

Remarks.—This study demonstrates that the populations from Koshiki Islands, Uji, Kuchierabu and Mishima Islands are specifically distinct from the Japanese mainland (Kyushu to Honshu) population, as discussed below.

It is worthwhile to mention about the specific identity of *G. dehaani* to fix nomenclature. *Geothelphusa dehaani* was

described based on specimens collected by Philipp Franz von Siebold during his stay in Japan in 1823–1829, especially during travel from Nagasaki to Edo (Tokyo) in 1826 (Holthuis & Sakai, 1970). These specimens are still extant and housed in the collections of the Nationaal Natuurhistorisch Museum, Leiden. As the holotype of *G. dehaani* was not originally designated, Yamaguchi (1993) selected a lectotype for *G. dehaani*. However, since the localities of the type specimens are indicated only as “Japan”, the precise sampling locality of the lectotype, as well as the paralectotypes, are uncertain. Drs. Darren C. J. Yeo and T. Naruse, who examined the lectotype, kindly informed us that the G1 of the lectotype gently curves outwards, and its ultimate segment strongly curves upwards and inwards. We are now convinced that the lectotype represents the Japanese mainland populations. The specimens from the southern part of the main island of Kyushu, examined in this study for comparison, can be safely referred to *G. dehaani*.

Primarily, the structure of the G1 differs among the two new species and *G. dehaani*. In *G. koshikiensis*, G1 consists of an almost straight penultimate segment and straight ultimate segment with a short terminal process (Figs. 2c, 3f). In *G. mishima*, the penultimate segment is strongly curved laterally and the ultimate segment slightly curved mesially and tapers to a long terminal process (Figs. 5c, 6g). In *G. dehaani*, the penultimate segment is gently curved outwards and the ultimate segment with a short terminal process is strongly curved upwards and inwards, as mentioned above.

Furthermore, the position of the greatest width of the carapace is significant in differentiating *G. koshikiensis* from *G. dehaani* [across anterior 0.30 ± 0.03 of length ($N=12$) in *G. koshikiensis*; versus anterior 0.34 ± 0.02 of length ($N=36$) in *G. dehaani*; Mann-Whitney's *U*-test, $P < 0.01$]. The ornamentation of the infraorbital margin and the sulcus on the pterygostomial region of the carapace differentiates *G. mishima* from *G. dehaani* and *G. koshikiensis*. In *G. dehaani* and *G. koshikiensis*, the infraorbital margin is smooth, but granulate in *G. mishima*; the sulcus on the pterygostomial region lacks

granules in *G. koshikiensis* and *G. dehaani*, but it is filled at least partially with granules in *G. mishima*. The carpus of the chelipeds has small spiniform tubercles on the outer surface in *G. mishima*, but such tubercles are absent in *G. koshikiensis* and *G. dehaani*. The coloration of the pereopods is also different among the three species. In *G. koshikiensis* the chelipeds are entirely red and ambulatory legs are reddish brown; in *G. mishima*, the chelipeds and ambulatory legs have usually small black spots scattered on the entire surfaces; and in *G. dehaani*, the chelipeds and ambulatory legs are milky white, brown, or reddish orange in the posterior surfaces and milky white in the anterior surfaces, lacking black spots.

The other four congeneric species, *G. bicolor* Shy, Ng & Yu, 1994 from Taiwan, *G. exigua*, *G. minei* from the Yaeyama Islands, Ryukyu Archipelago, and *G. shokitai* from the Senkaku Islands, Ryukyus Archipelago, are morphologically similar to the two new species by having a medium body size (attaining up to 30.0 mm in CW), the carapace with a smooth dorsal surface, the anterolateral margin of the carapace lined with small rounded granules and the absence of an epibranchial tooth. *Geothelphusa bicolor*, *G. minei* and *G. shokitai* are similar to *G. koshikiensis* in the nearly straight G1. Nevertheless, in the former three species, the ultimate segment of the G1 gradually tapers distally, rather than forming a short, distally widened process in *G. koshikiensis*. Furthermore, the mesial cup-like structure on G2 is more distally located in *G. bicolor* than in *G. minei*, *G. koshikiensis* and *G. shokitai*. *Geothelphusa mishima* and *G. exigua* share strongly laterally curved G1. However, the G1 is more stout in *G. exigua* than in *G. mishima*; the ultimate segment is curved laterally in *G. exigua*, rather than slightly recurved mesially in *G. mishima*. The coloration of the carapace also differentiates the two new species from *G. bicolor*, *G. exigua* and *G. minei*. The carapace of *G. koshikiensis* is dark reddish brown and that of *G. mishima* is reddish orange. By comparison, the carapace of *G. bicolor* is dark brown in the anterior half and yellowish brown in the posterior half; in *G. exigua* it is chocolate brown with scattered black spots;

and in *G. minei*, it is brown. The coloration in life of *G. shokitai* is unknown.

In Koshiki Islands, *G. koshikiensis* and *G. dehaani* are found sympatrically. Reexamination of the material used by Okano *et al.* (2000) for investigating genetic divergence among the local populations referred to *G. dehaani* has shown that the five specimens from Koshiki Islands (specimens No. 25R, 26R, 27R, 28R, and 29R) actually represent *G. koshikiensis*. Similarly, the specimens from Uji, Kuchierabu, and Kuroshima (one of Mishima Islands) islands, used by Okano *et al.* (2000) (specimens No. 30B, 31R, and 32R), have been confirmed to be *G. mishima*.

Acknowledgements

We thank Dr. Tomoyuki Komai of the Natural History Museum and Institute, Chiba, for his critical reading of the manuscript. Thanks are also extended to Drs. Peter K. L. Ng and Darren Yeo of the National University of Singapore, and Tohru Naruse of University of the Ryukyus for their critical readings and valuable reviews on the manuscript, and for their kind help in describing characteristics of lectotype of *G. dehaani*.

Literature Cited

- Bott, R., 1967. Potamiden aus Ost-Asien (*Parapotamon* De Man, *Sinopotamon* n. gen., *Candidiopotamon* n. gen., *Geothelphusa* Stimpson) (Crustacea, Decapoda). *Senckenbergiana Biologica* 48: 203-220.
- , 1970. Die Susswasserkrabben von Europa, Asien, Australien und ihre Stammesgeschichte. Eine Revision der Potamoidea und der Parathelphusoidea. (Crustacea, Decapoda). *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft* 526: 1-338 + pls. 1-58.
- Chokki, H., 1976. Preliminary report of the colouration of freshwater crab, *Geothelphusa dehaani* (White), with special reference to its distribution. *Researches on Crustacea* (Former issue of *Crustacean Research*) (7): 177-182, pl. XIII. (in Japanese with English abstract)

- , 1980. Notes on the colouration of freshwater crab, *Geothelphusa dehaani* (White), in northern districts of Japan. Researches on Crustacea (Former issue of Crustacean Research) (10): 57-60. (in Japanese with English abstract)
- Dai, A., 1999. Fauna Sinica, Arthropoda Crustacea Malacostraca Decapoda Parathelphusidae Potamidae. Editorial Committee of Fauna Sinica, Academia Sinica, i-xiii, 501 pp., pls. I-XXX. (in Chinese with English abstract).
- De Haan, W., 1833-1850. Crustacea. In P. F. von Siebold, Fauna Japonica sive descriptio animalium, quae in itinere per Japoniam, jussu et auspiciis superiorum, qui summum in India Batava imperium tenent, suscepto, annis 1823 - 1830 collegit, Notis, observationibus et adumbrationibus illustravit, i-xvii, i-xxxi, ix-xvi, 243 pp., pls. A-J, L-Q + 1-55; Lugduni-Batavorum. (Leiden).
- Holthuis, L. B., & Sakai, T., 1970. Ph. F. Von Siebold and Fauna Japonica. A History of Early Japanese Zoology. Academic Press of Japan, Tokyo. 323 pp.
- Kasai, H., & Naruse, T., 2003. Potamidae. In: Nishida, M., Shikatani, N., Shokita, S., eds. The flora and fauna of inland waters in the Ryukyu Islands. Tokai University Press, Tokyo. p 282-288. (in Japanese).
- Minei, H., 1973. Potamoid crabs of the Ryukyu Islands, with descriptions of five new species (Crustacea, Decapoda, Potamoidea). Journal of the Faculty of Agriculture, Kyushu University 17: 203-226.
- , 1974. Studies on the freshwater crabs of Japan I. Genus *Geothelphusa* Stimpson. The Nature and Animals 4: 8-12 (in Japanese).
- Nakajima, K., & Masuda, T., 1985. Identification of local population of freshwater crab *Geothelphusa dehaani* (White). Bulletin of Japanese Society of Scientific Fisheries 51: 175-181.
- Naruse, T., & Shokita, S., 2009. *Geothelphusa amagui*, a new species of the true freshwater crab (Crustacea, Decapoda, Potamidae) from Kerama Island Group and Kume Island, central Ryukyu Islands, Japan. Bulletin of the National Museum of Nature and Science, Series A (Zoology), Supplement 3: 191-198.
- , ———, & Nagai, T., 2005. Taxonomy of the terrestrial crab *Geothelphusa tenuimanus* (Crustacea: Decapoda: Brachyura: Potamidae) of Okinawa Island, Central Ryukyus, Japan. Species Diversity, 10: 171-184.
- , ———, & Ng, P. K. L., 2006. A revision of the *Geothelphusa levicervix* species group (Crustacea: Decapoda: Brachyura: Potamidae), with descriptions of three new species. Journal of Natural History, 40: 759-781.
- , ———, & Shy, J.-Y., 2004. A new species of the freshwater crab, previously assigned to *Geothelphusa miyazakii* (Miyake & Chiu, 1965) (Crustacea: Decapoda: Potamidae), from Yaeyama group, southern Ryukyus, Japan. Raffles Bulletin of Zoology, 52: 109-116.
- , Segawa, R. D., & Aotsuka, T., 2007. Two new species of freshwater crab (Crustacea: Decapoda: Potamidae) from Tokashiki Island, central Ryukyu Islands, Japan. Systematics and Biodiversity, 5: 409-415.
- Ng, P. K. L., Guinot, D., & Davie, P. J. F., 2008. Systema Brachyurorum: Part I. An annotated checklist of extant brachyuran crabs of the world. Raffles Bulletin of Zoology, Singapore, Supplement 17: 1-286.
- Okano, T., Suzuki, H., Hiwatashi, Y., Nagoshi, F., & Miura, T., 2000. Genetic divergence among local populations of the Japanese freshwater crab *Geothelphusa dehaani* (Decapoda, Brachyura, Potamidae) from southern Kyushu, Japan. Journal of Crustacean Biology, 20: 759-768.
- Rathbun, M. J., 1904. Les crabes d'eau douce. Nouvelles Archives du Museum d'Histoire Naturelle 6: 225-312.
- Shih, H.-T., & Shy, J.-Y., 2009. *Geothelphusa makatao* sp. nov. (Crustacea: Brachyura: Potamidae), a new freshwater crab from an uplifted Pleistocene reef in Taiwan. Zootaxa, 2106: 51-60.
- , ———, & Lee, J.-H., 2010. A new freshwater crab of the genus *Geothelphusa* (Brachyura, Potamidae) from southwestern Taiwan. Crustaceana Monographs, 14:

- 661-675.
- Shokita, S., Naruse, T., & Fujii, H., 2002. *Geothelphusa miyakoensis*, a new species of freshwater crab (Crustacea: Decapoda: Brachyura: Potamidae) from Miyako Island, southern Ryukyus, Japan. *Raffles Bulletin of Zoology*, 50: 443-448.
- Shy, J.-Y., & Ng, P. K. L., 1998. On two new species of *Geothelphusa* Stimpson, 1858 (Decapoda, Brachyura, Potamidae) from the Ryukyu Islands, Japan. *Crustaceana* 71:778-784.
- , ———, & Yu, H.-P., 1994. Crabs of the genus *Geothelphusa* Stimpson, 1858 (Crustacea: Decapoda: Brachyura: Potamidae) from Taiwan, with descriptions of 25 new species. *Raffles Bulletin of Zoology* 42: 781-846.
- Stimpson, W., 1858. *Prodromus descriptionis animalium evertetorum, quae in Expeditione ad Oceanum Pacificum Septentrionalem, a Republica Federata missa, Cadwaladaro Ringgold et Johanne Rodgers Ducibus, observavit et descripsit, pars 5, Crustacea Ocypodidea*. *Proceedings of the Academy of Natural Sciences of Philadelphia* 10: 93-111.
- Sugawara, K., & Gamo, S., 1984. Differentiation of the local populations of the Japanese freshwater crab, *Geothelphusa dehaani* (White) in southern Honshu and Shikoku in Japan. *Bulletin of Biogeographical Society of Japan*. 39: 33-37. (in Japanese with English abstract)
- Suzuki, H., 2001. A comment on the geological formation of the Mishima Islands (Takeshima, Ioujima and Kuroshima) as inferred from their freshwater crustacean faunas. *Kagoshima University Research Center for the Pacific Islands, Occasional Papers*, No. 34: 137-140.
- , & Okano, T., 2000. A new freshwater crab of the genus *Geothelphusa* Stimpson, 1858 (Crustacea: Decapoda: Brachyura: Potamidae) from Yakushima Island, southern Kyushu, Japan. *Proceedings of Biological Society of Washington*, 113: 30-38.
- , & Sato, M., 1994. Kagoshima nature guide – Freshwater shrimps, crayfish, and crabs. Nishi Nippon Newspaper Co., Fukuoka, 137 pp. (in Japanese)
- , & Tsuda, E., 1991. Study on the Color Variation and Distribution of a Freshwater Crab, *Geothelphusa dehaani* (White), in Kagoshima prefecture. *Benthos Research*, No. 41: 37-46. (in Japanese with English abstract)
- , & ———, 1994. A new freshwater crab of the genus *Geothelphusa* (Crustacea: Decapoda: Brachyura: Potamidae) from Kagoshima Prefecture, Southern Kyushu, Japan. *Proceedings of the Biological Society of Washington* 107: 318-324.
- Tan, S.-H., & Liu, H.-C., 1998. Two new species of *Geothelphusa* (Decapoda: Brachyura: Potamidae) from Taiwan. *Zoological Studies* 37: 286-290.
- Yamaguchi, T., 1993. The contributions of von Siebold and H. Burger to the natural history of Japanese Crustacea. 15-598. In Yamaguchi, T. ed., *Ph. F. von Siebold and Natural History of Japan. Crustacea. The Carcinological Society of Japan, Tokyo*. (in Japanese)

Addresses:(HS) (TK) Marine Biological Laboratory, Faculty of Fisheries, Kagoshima University, 4-50-20 Shimoarata, Kagoshima 890-0056, Japan.

Email: (HS) suzuki@fish.kagoshima-u.ac.jp

RECEIVED: 24 March 2011.

ACCEPTED: 4 November 2011.